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(71) Applicant(s)

Robert John Wilson
5 Strandview Cottages, Castlerock, COLERAINE,
BT51 4XS, United Kingdom

Terence John McCavana
54 Seaciff Road, BANGOR, County Down, BT20 5EZ,
United Kingdom

David Campbell Morrison
47 Ormonde Park, BELFAST, BT10 0LT,
United Kingdom

(72) Inventor(s)

Robert John Wilson
Terence John McCavana
David Campbell Morrison

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GB 2305818 A WO 97/47126 A1 WO 97/26750 A1
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(74) Agent and/or Address for Service

Murgitroyd & Company
373 Scotland Street, GLASGOW, G5 8QA,
United Kingdom

(54) Abstract Title

Remote control and monitoring of devices over the Internet using electronic mail

(57) Data from a device 1 capable of originating and receiving data is sent to a discrete hardware and embedded software unit 2 comprising a hardware interface 4, a microprocessor logic chip 5 and modem 6. The unit 2 encodes the data and transmits it by electronic mail via the Internet to a remote computer 3 for further processing and logging. Alternatively the data is transmitted via an intranet, PSTN or radio network. Control data may also be transmitted to the device. The device may be a gas or electricity meter which is remotely read. Security means includes a watchdog timer for resetting the microprocessor logic chip and means to stop transmission in the event of a predetermined number of transmission errors.

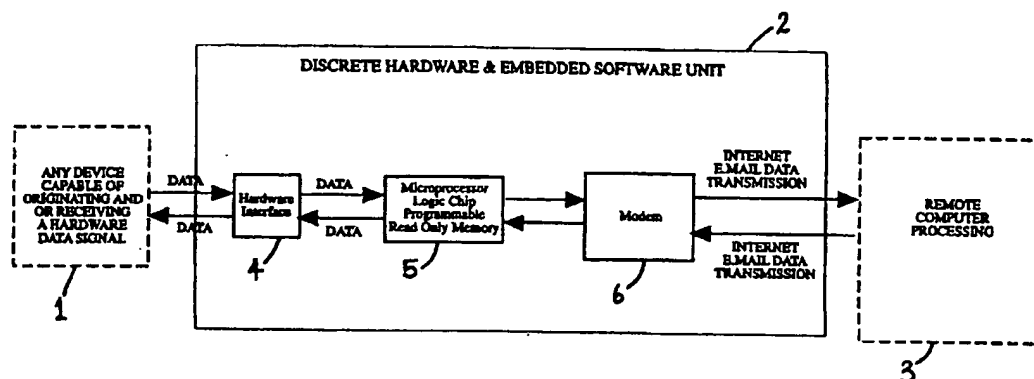


Fig. 1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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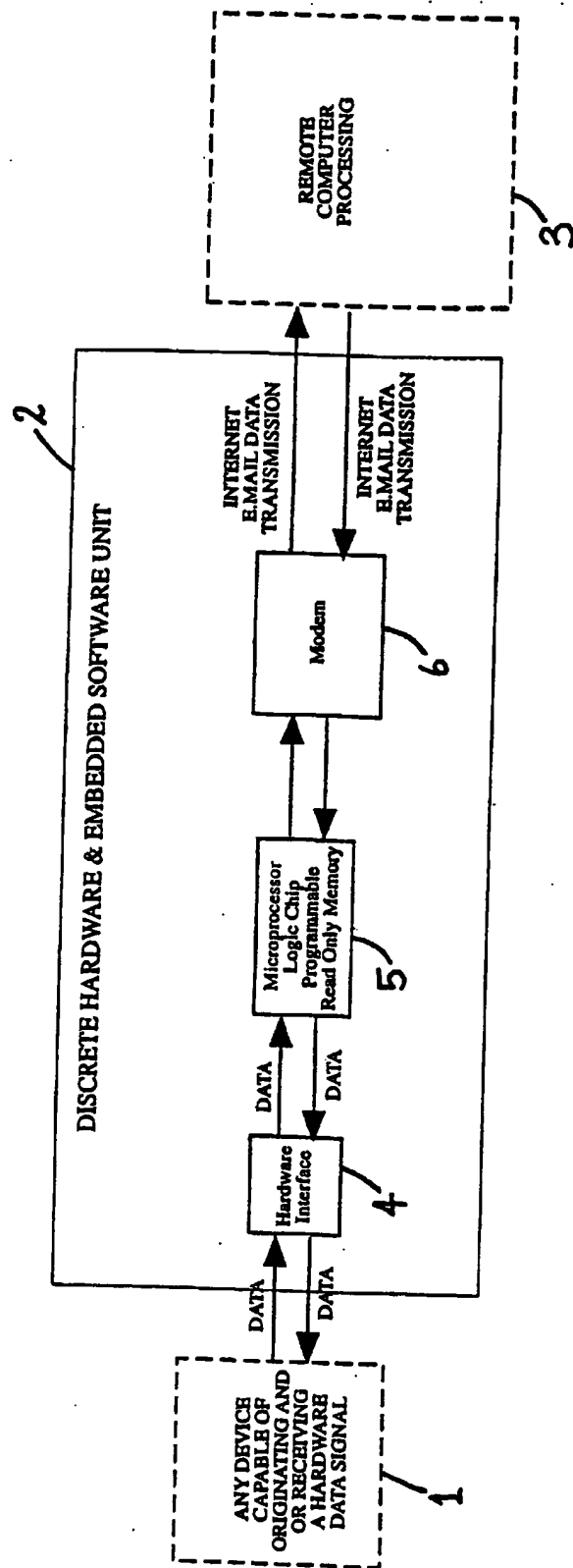


Fig. 1

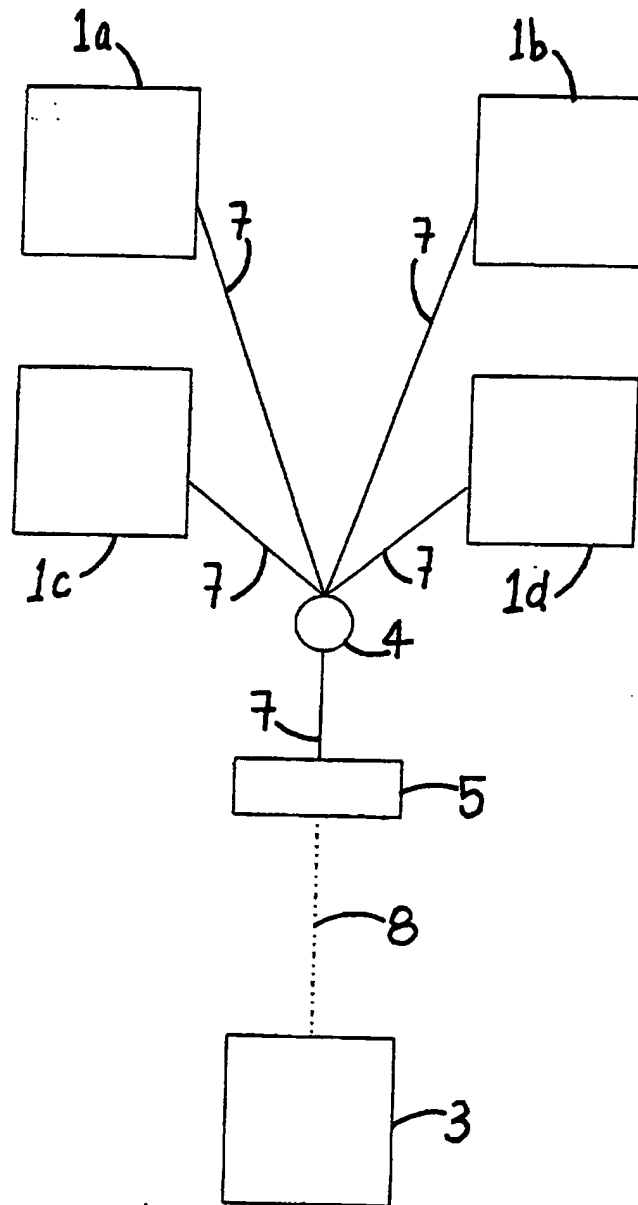


Fig. 2

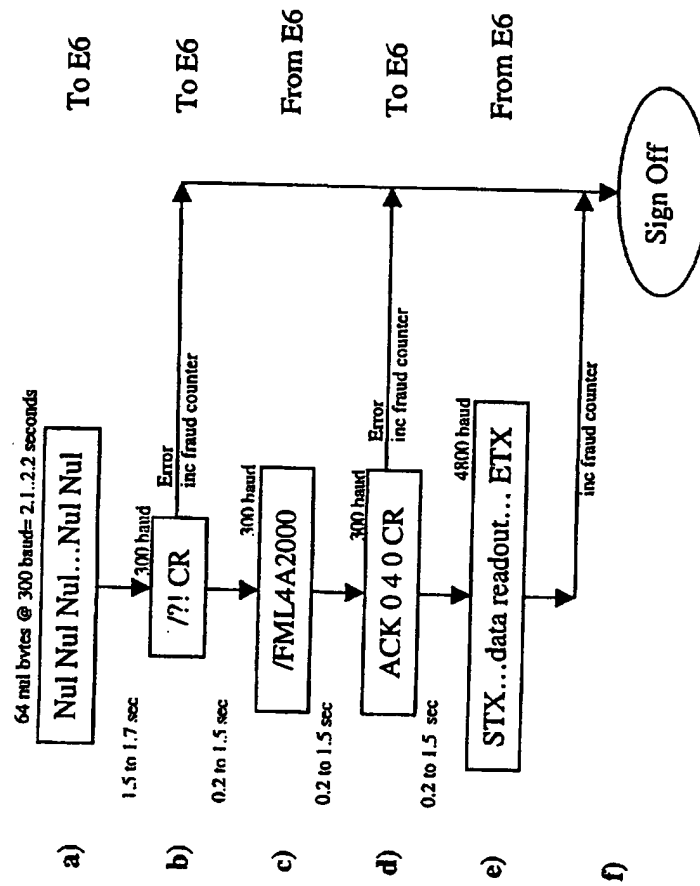


Fig. 3

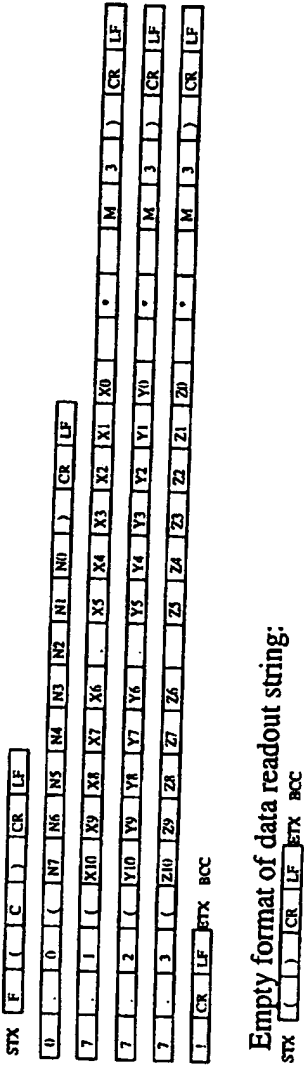


Fig. 4

1 **"Data Transmission System"**

2

3 The present invention relates to a data transmission
4 system, and in particular to a data transmission system
5 which establishes a two way communication between a
6 remote computer processor and a device, machine or
7 apparatus; the two way communication taking place at
8 least in part by an electronic mail message via a
9 computer network such as the Internet to provide remote
10 control and monitoring functionality to embedded
11 systems.

12

13 According to a first aspect of the present invention,
14 there is provided a data transmission system having a
15 hardware interface for sending and receiving data
16 to/from a data producing device; a data encoder which
17 receives and sends data from/to the hardware interface;
18 a network communicator, for receiving and sending
19 encoded data from/to the data encoder and also for
20 receiving and sending data from/to a remote computer
21 for processing.

22

23 Preferably, the data encoder is a Microprocessor Logic
24 Chip.

25

1 Preferably, the network communicator is a modem.

2

3 Preferably, the data encoder receives and sends data
4 from/to the remote computer via a computer network such
5 as the Internet or Intranet.

6

7 In use, the data is sent either automatically or on the
8 request of the remote computer.

9

10 According to a second aspect of the present invention,
11 there is provided a method of transmitting data
12 comprising the steps of: collecting data from a data
13 producing device; sending said data to a data encoder
14 via a hardware interface; sending said encoded data to
15 a network communicator which sends said encoded data to
16 a remote computer for processing.

17

18 Preferably, the data encoder is a Microprocessor Logic
19 Chip and the network communicator is a modem.

20

21 Preferably, the data encoder receives and sends data
22 from/to the remote computer via a computer network such
23 as the Internet or Intranet.

24

25 Preferably, the data transmitted between the network
26 communicator and the remote computer is in the form of
27 electronic mail.

28

29 Preferably, the data can also flow in the opposite
30 direction thus enabling the remote computer to
31 communicate with the data producing device.

32

33 Preferably, there is provided security means for
34 inhibiting the system in the event of a predetermined
35 number of consecutive error signals.

36

1 The Microprocessor Logic Chip may be a programmable
2 Read Only Memory (ROM). In use, the Microprocessor
3 Logic Chip may be a chip set.

4

5 The network communicator may connect to the computer
6 network by means of a standard PSTN connection or
7 dedicated line, by radio signal, mobile telephony or by
8 optical fibre.

9

10 Embodiments of the present invention will now be
11 described, by way of example only, with reference to
12 the accompanying drawings, in which:

13

14 Fig. 1 is a schematic block diagram of the system
15 of the present invention;

16

17 Fig. 2 is a schematic block diagram of one
18 application of the present invention;

19

20 Fig. 3 is a flow diagram showing the communication
21 between a meter and an optical communications
22 protocol, in another application of the present
23 invention; and

24

25 Fig. 4 is an example of a readout string from the
26 meter of Fig. 3.

27

28 Referring to Fig.1, there is illustrated a device 1
29 capable of originating data to be sent to a discrete
30 hardware and embedded software unit 2 which provides
31 the means for electronically mailing data from the
32 device 1 to a remote computer 3 either automatically or
33 on the request of the remote computer 3. This data is
34 sent initially to a hardware interface 4 which provides
35 a data bridge between the device 1 and a Microprocessor
36 Logic Chip 5.

1 The Microprocessor Logic Chip 5 processes the data
2 received from the hardware interface 4 and communicates
3 the processed data through a modem 6 by electronic mail
4 via the Internet in a conventional manner to the remote
5 computer 3 for further processing and logging. The
6 modem being suitable for connection to PSTN (Public
7 Switched Telephone Network) with a transfer rate of at
8 least 2400 baud.

9
10 The modem 6 is of modular construction.

11
12 The remote computer 3 can also communicate with the
13 device 1 by electronically mailing, via the Internet in
14 the conventional manner, data which is then picked up
15 by the Microprocessor Logic Chip 5 via the modem 6
16 connection to the Internet. The Microprocessor Logic
17 Chip 5 then processes the electronic mail data and
18 transmits it to the hardware interface 4 which in turn
19 communicates this data to the device 1. The device 1
20 then responds in a pre-programmed way to the data which
21 it receives.

22
23 By way of illustration, the system will now be
24 described as applied to an electricity meter.
25 Referring to Fig.2, there is illustrated four
26 electricity meter devices 1a to 1d. The devices 1a to
27 1d are capable of generating data regarding the amount
28 of electricity used (for example, a data string 1,105
29 would represent meter 1 and a meter reading of 105
30 units). Each of the meters 1a to 1d produces this data
31 stream automatically and transmits the data by a
32 suitable means 7 (for example, by a fixed line or by
33 radio transmission) to a hardware interface 4 which
34 processes this data and communicates it by a suitable
35 means 7 to a processor 5 which contains a
36 Microprocessor Logic Chip and a modem. The

1 Microprocessor Logic Chip processes the data for
2 sending by electronic mail via the Internet 8 to a
3 remote computer 3. The remote computer 3 can then
4 process and log the meter readings of each device 1a to
5 1d.

6
7 The remote computer 3 can also communicate with each
8 device 1a to 1d by sending data by electronic mail via
9 the Internet 8 to the processor 5 which can then
10 communicate the data to each device 1a to 1d by way of
11 the hardware interface 4. This is useful, for example,
12 if the supplier of the electricity wishes to suspend
13 their supply. The action that each device 1a to 1d
14 takes is dependent on their pre-programming.

15
16 Electricity meters, especially older models generally
17 operate on a rotating disk principle, where the number
18 of rotations of the disk is proportional to the amount
19 of electricity being consumed. These types of meters
20 can be modified to generate a pulse train, the
21 frequency of which is proportional to the amount of
22 energy being consumed.

23
24 The system is also provided with security means which
25 comprises a watchdog timer which needs to be regularly
26 triggered by the application code of the software.
27 After five seconds the watchdog timer will expire and
28 the Microprocessor Logic Chip 5 will automatically
29 reset. The watchdog timer can be disabled during
30 development work on the system.

31
32 The system is also provided with a power down function
33 which reduces power consumption by powering down parts
34 of the electronics which consume excessive power. This
35 is achieved by power switching during periods of
36 inactivity.

1 An input pulse counter is also provided for counting
2 rising or falling transitions of an external input
3 signal.
4
5 The software used to drive the hardware described
6 comprises an initialisation routine, device drivers and
7 system modules. The software is written on
8 conventional software development programs.
9
10 The initialisation routine is activated by the hardware
11 power-up trigger and automatically executes the startup
12 code as well as also disabling interrupts and
13 initialising the serial driver and the pulse count
14 driver.
15
16 The serial driver sends and receives messages over a
17 single serial interface.
18
19 An error recovery module is provided which places an
20 appropriate message in a message log when exception or
21 status information is reported.
22
23 The system is capable of operation over the standard
24 commercial temperature range (0 to 70 deg C).
25
26 At a predetermined time, a process input module
27 arranges for the meter to be read by sending and
28 receiving messages via the serial driver to the meter.
29
30 The meter reading is formatted and sent to a create
31 email module.
32
33 The meter reading is inserted into an email message
34 template and the email is sent.
35
36 By way of further illustration of a specific

1 application of the invention, the system will now be
2 described as applied to a gas meter and the optical
3 communication protocol used in the gas meter to allow
4 interrogation of basic metrology data via the IEC 1107
5 optical communications protocol.

6

7 The data format is 1 start bit, 7 data bits, 1 parity
8 bit, 1 stop bit, even parity. Information is
9 transmitted as 7 bit ASCII, including numeric data.

10

11 The procedure to establish optical communication with
12 the meter and obtain volume data is described here
13 using the fixed 300 baud and normal 4800 baud rates.
14 Steps a) to f) below are shown in the flow diagram of
15 Fig. 3.

16

17 a) Because the meter is battery powered, optical
18 communication has to be enabled when required, to
19 conserve energy. This is achieved by transmitting
20 a "Null string" to the meter which is 2.1 seconds
21 in duration and sent at 300 baud.

22

23 b) Next an identification request is transmitted
24 to the meter "/?!CRLF" (at 300 baud). This
25 corresponds to an ASCII string 2F3F210D0A. If the
26 message received by the meter is not "/?!CRLF" the
27 meter increments its fraud counter and stops the
28 communication session.

29

30 c) The meter should respond with an identification
31 string. The content will depend on the meter
32 model, but is generally of the form "/FML4"
33 followed by 12 more ASCII characters. This string
34 is transmitted at 300 baud. Typical
35 identification strings are-

36

"/FML4BGas Ser IAA"

1 "/FML4A2000 Ser 2"

2 The identification strings are used for more
3 complex communications to assist set-up of the
4 session. For data readout, the identification
5 string content is superfluous. A check that the
6 first character received from the meter is "/" is
7 sufficient.

8
9 d) The module must then request the data readout
10 message by sending the following string-

11 "Ack 0 4 0 CR LF" in ASCII 063034300D0A

12 The character "4" is an indicator of the baud rate
13 at which the data readout message is expected.

14 The default set-up of the Gas Meter is 4800 baud -
15 "4". Alternatives are-

Char	baud
0	300
1	600
2	1200
3	2400
4	4800
5	9600

16
17
18
19
20
21
22
23
24 If the baud rate character sent to the meter does
25 not match the baud character sent from the meter
26 in its identification string "/FML4A2000 Ser 2"
27 the meter will increment its fraud counter and
28 terminate the communication session. The meter
29 will also record the baud character sent to it in
30 the "Ack 0 x 0 CR LF" message and will use this
31 next time the identification message is
32 transmitted from the meter.

33
34 If the selected hi-speed rate is 300 baud, there
35 is not enough time to send the Data Readout
36 String, so the meter replies with an "empty"

1 string, 7 characters long.

2

3 e) Within 0.2 to 1.5 seconds the meter will
4 respond with a data readout string at the baud
5 rate specified in the acknowledge/request for
6 readout string just sent to the meter.

7

8 f) After the readout string has been transmitted,
9 the meter shuts down the optical communication ie
10 "signs off". If the readout string is required
11 again, the communication process must be repeated
12 from the wakeup null string.

13

14 To prevent excessive power drain of the battery by
15 repeated data readout requests, each time a request is
16 received, a communication error (fraud counter) is
17 incremented. If the counter value exceeds 3, the meter
18 "locks out" optical communication until the next hour
19 change of the real time clock in the meter. If more
20 than 3 further data readout requests are received, the
21 meter locks out optical communication until 24.00. At
22 24.00 the communication fraud counter is reset to 0 and
23 optical communication is allowed. It is not possible
24 to request the data readout string more than 6 times in
25 a 24 hour period.

26

27 The Data Readout string from the meter is an output
28 giving the meter volume, temperature compensated volume
29 and negative volume, and a fault flag code, it is sent
30 in response to the sign-on acknowledge string ACK 0 X 0
31 CR LF, (X is the baud select digit, 4=4800 baud).

32

33 Normal Format of Readout String is shown in Fig. 4
34 wherein:

35

36 C Fault flag ASCII code of

1 A,b,C,d,E,F,H,L,n,P,r,t,U, or 0 (zero) if no
2 fault
3
4 N 7..0 Serial number of gas meter, 8 digit ASCII
5 coded decimal N0 is the least significant
6 digit
7
8 X 10..0 Meter volume, 11 digit ASCII coded decimal X0
9 is the least significant digit. A full stop
10 character separates digit 6 and 5
11
12 Y 10..0 Temperature corrected volume, 11 digit ASCII
13 coded decimal Y0 is the least significant
14 digit. A full stop character separates digit
15 6 and 5.
16
17 Z 10..0 Reverse volume, 11 digit ASCII coded decimal
18 Z0 is the least significant digit. A full
19 stop character separates digit 6 and 5.
20
21 The three meter index values X, Y, Z are in cubic
22 meters, the full stop character represents the decimal
23 point of each value.
24
25 Module communication software provided should be able
26 to respond to communication failures, detect
27 communication lock-outs and be able to switch between
28 the initial 300 baud rate and the 4800 hi-speed baud
29 rate.
30
31 If a message other than the identification request
32 "/?!CRLF" is sent after the null byte wake up string
33 the meter will increment its fraud counter and
34 terminate the communication session.
35
36 If there is no response from the meter to the request

1 "/?!CRLF" message then the meter has accumulated
2 sufficient fraud or failed attempts to shut down serial
3 communication until either the next hour change or the
4 next day change of the gas meter real time clock.
5
6 Communication is started at 300 baud, the meter will
7 normally switch to 4800 baud after this point. For the
8 remaining data readout communication to occur, the
9 module should have sent a "4" in its acknowledge
10 message. If the module sends a different character,
11 the meter will respond with a NAK (Negative
12 Acknowledgement) character, terminate the communication
13 session (sign off) and increment the fraud counter. It
14 will record the baudrate character and use this to
15 compare with the next baudrate character it receives in
16 the next sign-on attempt. When they match,
17 communication continues at that baudrate.
18
19 This feature allows a module to set-up the meter to
20 respond at a different hi-speed baud rate than the
21 factory configured 4800 baud. Once it has been changed
22 by the 2 pass sign on process described above, future
23 sign ons will normally succeed first time.
24
25 The highest level of active fault code in the meter is
26 shown as a single ASCII character in the position
27 described in section 4. Data Readout String
28 Definition. The letter correspond to the fault code
29 letter shown on meter display. If no faults are
30 detected, the data readout string will substitute 0
31 (number zero, ASCII 30 hex), and the meter fault
32 display character will be blank.
33
34 The fault code letters that can be displayed and
35 included in the data readout string are:
36 A,b,C,d,E,F,H,Ln,P,r,t,U, or 0 (Zero) if no fault

1 Letter A is the most significant fault level, U is the
2 least significant fault level.

3
4 Whilst the above illustrates the use of the present
5 invention in relation to electricity meters and
6 describes by way of specific example the application to
7 a gas meter. The present invention can also be applied
8 to water meters, tachographs, temperature sensors,
9 pressure sensors, meteorological measurement systems,
10 magnetic swipe cards, movement detectors, Ph meters,
11 clock card systems, computers, ammeters, volt meters,
12 resistance meters, time measurement systems, distance
13 measurement systems, cameras, video cameras, chemical
14 analysis systems, radio systems, flow meters, weighing
15 machines, bar code readers, counting systems, velocity
16 measurement systems, depth measurement systems, echo
17 sounders, compass systems, optical systems, sound
18 measurement systems, tensile measurement systems, gas,
19 smoke, and fire detectors, wetness systems, rotational
20 measurement systems, magnetometers, photocopiers and
21 traffic speed cameras for example.

22
23 The electronic mail message may also be transmitted via
24 an Intranet network.

25
26 Modifications and improvements may be made to the
27 foregoing within the scope of the present invention.

1 **CLAIMS**

2

- 3 1. A data transmission system having a hardware
4 interface for sending and receiving data to/from a
5 data producing device; a data encoder which
6 receives and sends data from/to the hardware
7 interface; a network communicator, for receiving
8 and sending encoded data from/to the data encoder
9 and also for receiving and sending data from/to a
10 remote computer for processing.
- 11
- 12 2. A data transmission system according to Claim 1,
13 wherein the data encoder is a Microprocessor Logic
14 Chip.
- 15
- 16 3. A data transmission system according to either
17 preceding claim, wherein the network communicator
18 is a modem.
- 19
- 20 4. A data transmission system according to any
21 preceding claim, wherein the data encoder receives
22 and sends data from/to the remote computer via a
23 computer network such as the Internet or Intranet.
- 24
- 25 5. A data transmission system according to any
26 preceding claim, whereby in use the data is sent
27 either automatically or on the request of the
28 remote computer.
- 29
- 30 6. A data transmission system according to any
31 preceding claim, wherein there is provided
32 security means for inhibiting the system in the
33 event of a predetermined number of consecutive
34 error signals.
- 35
- 36 7. A data transmission system according to Claim 2,

- 1 wherein the Microprocessor Logic Chip may be a
2 programmable Read Only Memory (ROM). In use, the
3 Microprocessor Logic Chip may be a chip set.
4
- 5 8. A data transmission system according to any
6 preceding claim, wherein the network communicator
7 may connect to the computer network by means of a
8 standard PSTN connection or dedicated line, by
9 radio signal, mobile telephony or by optical
10 fibre.
11
- 12 9. A data transmission system according to any
13 preceding claim, wherein the data is derived from
14 an electricity meter, the data being
15 representative of the electricity measured by the
16 meter.
17
- 18 10. A data transmission system according to any of
19 Claims 1 to 8, wherein the data is derived from a
20 gas meter, the data being representative of the
21 gas measured by the meter.
22
- 23 11. A method of transmitting data comprising the steps
24 of: collecting data from a data producing device;
25 sending said data to a data encoder via a hardware
26 interface; sending said encoded data to a network
27 communicator which sends said encoded data to a
28 remote computer for processing.
29
- 30 12. A method of transmitting data according to Claim
31 11, wherein the data encoder is a Microprocessor
32 Logic Chip and the network communicator is a
33 modem.
34
- 35 13. A method of transmitting data according to either
36 of Claims 11 or 12, whereby the data encoder

1 receives and sends data from/to the remote
2 computer via a computer network such as the
3 Internet or Intranet.
4

5 14. A method of transmitting data according any of
6 Claims 11 to 13, whereby the data transmitted
7 between the network communicator and the remote
8 computer is in the form of electronic mail.
9

10 15. A method of transmitting data according any of
11 Claims 11 to 14, whereby the data can also flow in
12 the opposite direction thus enabling the remote
13 computer to communicate with the data producing
14 device.
15

16 16. A method of transmitting data according to any of
17 Claims 11 to 15, whereby the data is derived from
18 an electricity meter, the data being
19 representative of the electricity measured by the
20 meter.
21

22 17. A method of transmitting data according to any of
23 Claims 11 to 15, whereby the data is derived from
24 a gas meter, the data being representative of the
25 gas measured by the meter.
26

27 18. A data transmission system substantially as
28 hereinbefore described with reference to or as
29 shown in the accompanying drawings.
30

31 19. A method of transmitting data substantially as
32 hereinbefore described with reference to or as
33 shown in the accompanying drawings.
34



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16



INVESTOR IN PEOPLE

Application No: GB 9923196.1
Claims searched: All

Examiner: Gareth Griffiths
Date of search: 15 March 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.R): H4K (KOC), H4P (PEUL, PEUX, PPEC, PQA)

Int CI (Ed.7): H04M 11/00

Other: Online Databases: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2305818 A (RICOH) p.14 line 15 - p.19 line 22	1-17
X	WO97/47126 A1 (ET COMMUNICATIONS) FIG.1 & p.9 line 20 - p.11 line 7	1-12, 15-17
X	WO97/26750 A1 (CELLPORT) figs 1 & 2	1-8, 10-12, 15-17
X	US4833618 (VERMA) whole document	1-12, 15-17

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.